



Mount Rainier National Park

Sister Mountain Project

The TwiLIFE Zone

Overview	In this inquiry-based activity students will conduct a field study of four different environments as they focus on sunlight, soil, rock types, temperature, wind, water flow, plants, and animals in each environment. By comparing different environments, students will consider how nonliving elements influence living elements in an ecosystem.
Grade Level	5-8
Objectives	<ul style="list-style-type: none">Students will describe similarities and differences they observe in the non-living (abiotic) and living (biotic) components in four life zones.Students will identify ways that abiotic components of an ecosystem affect the biotic components.
Setting	Low-elevation Forest, mid-Elevation forest, subalpine forest/meadow, alpine ecosystem.
Time Frame	Preparation-60 minutes Travel time to study site varies Activity-one or more 50-minute periods per study site
Materials	<ul style="list-style-type: none">✓ Life Zones data table✓ Clipboard✓ Pencils✓ Trowel✓ Kestrel 3500 Weather Meter✓ Compasses✓ Clinometer✓ Soil chemistry testing kit✓ Bottle of deionized water✓ Topographic map of study sites✓ Appropriate field clothing for students✓ Field guides (rocks, plants, animals, tracks/scat, weather, etc.)
Vocabulary	Life zone, ecosystem, biodiversity, species
Standards	<p>6-8 LS2A An <i>ecosystem</i> consists of all the <i>populations</i> living within a specific area and the nonliving <i>factors</i> they interact with. One geographical area may contain many <i>ecosystems</i>.</p> <p>6-8 LS2B Energy flows through an <i>ecosystem</i> from <i>producers</i> (plants) to <i>consumers</i> to <i>decomposers</i>. These <i>relationships</i> can be shown for specific <i>populations</i> in a <i>food web</i>.</p>

	<p>6-8 LS2D <i>Ecosystems</i> are continuously changing. Causes of these changes include nonliving <i>factors</i> such as the amount of light, range of temperatures, and availability of water, as well as living <i>factors</i> such as the disappearance of different <i>species</i> through disease, <i>predation</i>, <i>habitat</i> destruction and overuse of resources or the introduction of new <i>species</i>.</p> <p>6-8 SYSA Any <i>system</i> may be thought of as containing <i>subsystems</i> and as being a <i>subsystem</i> of a larger <i>system</i></p> <p>6-8 SYSB The boundaries of a <i>system</i> can be drawn differently depending on the features of the <i>system</i> being <i>investigated</i>, the size of the <i>system</i>, and the purpose of the <i>investigation</i>.</p> <p>6-8 SYSF The <i>natural</i> and <i>designed world</i> is complex; it is too large and complicated to <i>investigate</i> and comprehend all at once. Scientists and students learn to define small portions for the convenience of <i>investigation</i>. The units of <i>investigation</i> can be referred to as "<i>systems</i>."</p> <p>6-8 INQA—Question—Scientific <i>inquiry</i> involves asking and answering <i>questions</i> and comparing the answer with what scientists already know about the world.</p> <p>6-8 INQC—Investigate—Collecting, analyzing, and displaying data are essential aspects of all <i>investigations</i>.</p> <p>6-8 INQI—Consider Ethics—Scientists and engineers have ethical codes governing animal <i>experiments</i>, research in natural <i>ecosystems</i>, and studies that involve human subjects.</p>
<p>Background</p>	<p>An ecosystem is a community of different species interacting with each other and with the chemical and physical factors making up its nonliving environment. It is a system of interrelationships among organisms, and between organisms and the physical environment.</p> <p>Plants and animals in an environment interact with each other in various ways. For example, plants may depend on insects or birds to pollinate flowers and on earthworms to aerate the soil. Animals may depend on plants for food or shelter. However, plants and animals also interact with the nonliving elements of their environment.</p> <p>In a local environment, physical factors such as sunlight, moisture, temperature, wind, rock type and water flow influence the suitability of an area for particular organisms. Those factors determine the kinds of plants and animals that live there. Physical factors may be determined by the environment's geography, such as its proximity to water, its elevation, or its</p>

geological features. In addition, the resident organisms (particularly plants) may affect the sunlight, moisture, temperature, and wind of the area. For example, the tall trees of the lowland forest such as Douglas-firs and hemlocks tend to block sunlight and thus create a dark, moist environment, or microclimate, on the forest floor that is suitable for shade-loving plants but is too shady for other kinds of plants. Microclimate refers to special conditions of light, moisture, and temperature that occur in a narrowly restricted area within an ecosystem, for example, under a bush or in a small woodland opening.

Low-Elevation Forest

518-762 meters

Mount Rainier's low-elevation forests have magnificent old-growth Douglas-fir, western red cedar, and western hemlock. Other associated tree species include the deciduous big-leaf maple, black cottonwood, and red alder along rivers. Dominant understory plants are the thorny devil's club, thimbleberry, vanilla leaf, oak fern, vine maple, and sword fern.

These forests are among the densest, most luxuriant, and most productive coniferous forests on Earth, and the dominant tree species are among the longest-lived and largest tree species found anywhere. Old-growth Douglas fir and western red cedar occasionally reach more than 1,000 years of age, heights of more than 250 feet, and diameters of 10-12 feet.

Animals that can commonly be found in this life zone include banana slugs, pacific giant salamanders, rubber boas, pileated and hairy woodpeckers, varied and Swainson's thrushes, Stellar's and gray jays, hoary and big brown bats, shrew moles, black-tailed deer, snowshoe hares, raccoons, mountain lions, and black bear.

Mid-Elevation Forest

762-1,220 meters

Though Douglas fir, western red cedar, and western hemlock may still occur, there are fewer as the elevation increases, until most sites are dominated by silver fir. In areas where fires have occurred, noble fir sometimes dominates a site for several hundred years before being overtaken by silver fir. In the understory, Alaska, black, oval-leaf, and red huckleberry are common. Other species include rhododendron and goatsbeard.

Animals that can be found here include long-toed salamanders, northwestern garter snakes, sharp-shinned hawks, great horned owls, elk, and black bear.

Subalpine Forest and Meadow

1,220-1,981 meters

Trees that grow in this life zone are well-adapted to heavy snow. Most have

flexible branches and a narrow profile that reduces damage from snow. Here we find mountain hemlock, sub-alpine fir, Alaska yellow cedar, and whitebark pine. Few of these species are abundant enough to form continuous forests, but grow as patches of trees amid meadows and snowfields. There are some differences in distribution among the species. Subalpine fir and whitebark pine are largely restricted to drier, warmer locations and are most common in the eastern and northeastern parts of the park. Nearly pure stands of subalpine fir grow in the upper basins of the Ohanapecosh and White River drainages. Whitebark pine grows best on rocky, wind-blown ridges where snow cover is not excessive. Associated understory species include beargrass avalanche lilies and glacier lilies.

The subalpine meadows at Mount Rainier are the largest and most spectacular in the entire Cascade Range. Beginning with the first snowmelt and continuing uninterrupted until the end of August, a colorful floral quilt blankets Rainier's slopes with fragrant blossoms.

Meadows are maintained amid what would otherwise be forested slopes for a variety of reasons. Typically, flowers dominate where snow lies deep. Trees require at least a two-month growing season. In many of the higher elevations of Mount Rainier, the time between snowmelt and new snow fall is so short that trees can't survive. In many subalpine settings, trees grow on the higher ridges and slopes where snow depth is lower, while flowers dominate the basins where snow collects. Cold air drainage can also limit tree growth. Cold air coming off Rainier's glaciers collects in basins. Even if they are snow free, the basins may be so cold that tree seedlings can't become established.

The wide variety of flowers found in the subalpine-alpine meadows includes speedwell, phlox, pink mountain heather, yellow mountain heather, dwarf lupine, Tolmie's saxifrage, beargrass, spring beauty, Sitka valerian, western anemone, buttercup, monkey flower, glacier lily, red paintbrush, bluebells, and a variety of asters and daisies.

Animals to be found here include rufous hummingbird, mountain bluebird, blue grouse, gray jay, Clark's nutcracker, Cooper's hawk, elk, black tailed deer, black bear, mountain goats, marmots and pikas.

Alpine

1,981-4,392 meters

This is a harsh landscape characterized by rocky outcrops and permanent snowfields. This life zone requires that any plant life be well-adapted for harsh conditions. Summer temperatures can still be freezing and gale force winds dominate. No trees will be found in this zone, however there are some hardy vascular plants such as heather and lupine. There are also non-vascular plants such as lichen and algae.

	<p>Animals are also scarce in this zone. However, some animals have found this zone to be a great place to live due to the lack of predators: white-tailed ptarmigans, gray-crowned rosy finches, ravens, spiders, deer mice, voles, and mountain goats.</p>
<p>Procedure</p>	<p>Preparation:</p> <ol style="list-style-type: none"> 1. Find four study sites (one in each of the four life zones). Possible study sites include Twin Firs (low-elevation forest), Trail of the Shadows (mid-elevation forest), Paradise Meadows (subalpine Forest/Meadow), and Muir Snowfield (alpine). If this activity is being conducted on school grounds consider a site that is open, like a field or lawn; one that has trees; and one that contains water. 2. Plan to visit the sites on the same day or on different days (at about the same time each day). Obtain any necessary permission to take students to visit the sites you have chosen. 3. Check the study sites beforehand to identify and possibly remove any safety hazards such as deep holes, sharp objects, or poisonous or irritating plants. 4. Arrange to have at least one parent volunteer, park ranger, teacher aide, or older student to help supervise students during outdoor investigations. This person will help the activity go more smoothly, ensure students' safety, and prevent damage to the sites. 5. Make copies of the student Life Zone Data Table for each team to record their observations. Using chart paper and marking pens, prepare a large chart for compiling each team's data, or plan to use spreadsheet software. 6. Have students practice using equipment like thermometers, compasses, and light meters. <p>Procedure:</p> <ol style="list-style-type: none"> 1. Ask students to think of a place they enjoy visiting in the park (Sunrise, Paradise, Mowich, Ohanapecosh, etc.) Ask them to think about these questions: <ul style="list-style-type: none"> • What did you particularly enjoy about the place? Was it the people? The physical space? The trees? • What did you do in this place? • What living things made this place enjoyable? (plants, animals) • Name any nonliving things that made your place enjoyable. (water, mountains, climate) <p>Help students see that a place has both living and nonliving parts that work together to make an ecosystem. Explain that students will investigate ecosystems-or life zones at four different study sites to find out how living and nonliving elements affect each other.</p> 2. Be sure to discuss appropriate outdoor behavior with students. (Refer

to *Mountain Manners* activity.) All living things, including plants, are to be respected and not injured in any way. Talk with students about following the rule: look, learn, leave alone.

3. Divide your class into teams. Explain that each team will investigate and record observations of a different component of the four different study sites. (if you have a large class have two teams study each component and then average their data.) Give students instructions on how to use field equipment, a copy of the Life Zone Data Table, and materials as described in the introduction. Later, teams will transfer their observations to the class data chart.

Team A - Soil

Ask this team to determine the soil moisture, pH, nitrogen, phosphorous and temperature at the study sites. Students can use a trowel or stick to scrape the surface of the ground and obtain a small sample of soil from underneath the surface. By feeling the soil, they should be able to tell whether it is wet, moist, or dry (moist soil will stick together). They should examine the soil for other characteristics such as texture, color, and smell. They should also note plant material or organisms in the soil.

Team B - Weather

Ask this team to measure each site's air temperature at chest height away from the body and out of the sun. They should also measure barometric pressure, humidity, wind speed/direction, and altitude. If the study site is a pond, river, or snowfield measure the temperature at just above the surface of water or snow at 1", and at chest height.

Team C - Lay of the Land

Ask this team to determine whether each site is flat or sloped and to record any other land features or rock type that might affect the study site (such as cliffs adjacent to it). This team will also determine which direction water flows from or through the study site. They can do so by slowly pouring water onto the ground and observing where it runs. They can also determine the direction of flow using a compass and topographic map.

Team D - Plant Life

Ask this team to observe the various kinds of plants at each site (large trees, small trees, shrubs, small plants, grasses, etc.) Suggest that students record the most common kinds of plants found in each location and that they note where each grows relative to the others.

Team E - Animal Life

Ask this team to record the various kinds of animals at each site (insects, birds, reptiles, amphibians, fish, and mammals). Students should include evidence of animals such as scat, tracks, burrows, or leaves that have been

	<p>chewed.</p> <ol style="list-style-type: none"> 4. After teams have had sufficient time to investigate each location, have them all come together to present their findings and share what they have learned. 5. Each team should listen to reports of the other teams, and use the information to complete their team chart. 6. Ask teams to enter their data on the large class chart or into a spreadsheet. Use this chart or spreadsheet as a basis for discussing differences between the study site locations and any interactions students observe among the elements. Ask the following questions: <ul style="list-style-type: none"> • Which ecosystem had the greatest number of plants? Animals? Which has the least of each? How do you explain this difference? • How were plants and animals the same at different sites? How were they different? • Which had the highest air temperature? The lowest? The most wind? The least? • Which had the wettest soil? The driest? • Do plants seem to affect the light intensity, air temperature, and soil temperature in an area? • How does water seem to influence the soil temperature, air temperature, and soil moisture? • What relationship does light seem to have with air temperature? With soil moisture? With plants? • How might water flow affect soil moisture and plants? • Which of the elements we studied seems most important for determining the character of the environment at each site? What makes you say so?
Suggested Assessment	<ul style="list-style-type: none"> • Give pairs or teams of students a large sheet of paper or access to graphic organizer software. Have students place the names of each of the elements studied (sunlight, soil, rock types, moisture, wind, temperature, water flow, plants, animals) in a large circle around the edge of the page. They should draw lines showing connections they observed between elements. On each line, have students briefly describe the relationship. For example, students might draw a line between sunlight and soil and then write, "When there is more sunlight, the soil is drier."
Adaptations	<p>If a trip to the park is not possible, adapt this activity to a local natural area that is within a short bus ride, or even within walking distance, of your school. If there are no study sites within close proximity to your school try adapting this activity to your school grounds.</p>
Extensions	<ul style="list-style-type: none"> • Visit each study site again at different times of the year and repeat your investigations. Compare your results: how has the soil changed? The temperature? The wind? The plants and animals? What factors

	<p>influenced each change?</p> <ul style="list-style-type: none">• Create a class terrarium of a local ecosystem, or have teams of students create terrariums of various ecosystems.
References/ Resources	<p><i>Project Learning Tree: Pre K-8 Environmental Education Activity Guide.</i> Washington, D.C.: American Forest Foundation Center for Environmental Learning, 2009. Print</p>

The Twi*LIFE* Zone

Life Zone Data Sheet

Team Members _____

Ecosystem	Low-Elevation Forest	Mid-Elevation Forest	Subalpine Forest/Meadow	Alpine
Soil <ul style="list-style-type: none"> • Moisture: wet, moist, or dry? • Texture and color? • Smell? • Temperature (2.54 cm deep) • pH • phosphorus • nitrogen • Organic material or organisms? • Shady, medium light, or bright? 				
Weather <ul style="list-style-type: none"> • Air temperature (°C) • Humidity (%) • Barometric Pressure (Hg) • Wind speed (km/h and direction (N, S, E, W, etc.)) • Altitude (m) 				

Lay of the Land <ul style="list-style-type: none"> • Flat or sloped • Land features (cliffs, glaciers) • Direction of water flow • Body of water into which site drains • Rock type 				
Plant Life <ul style="list-style-type: none"> • Most common kinds of plants • Where each kind grows relative to others 				
Animal Life <ul style="list-style-type: none"> • Animals seen • Animal evidence (scat, tracks, burrows, chewed twigs or leaves) 				